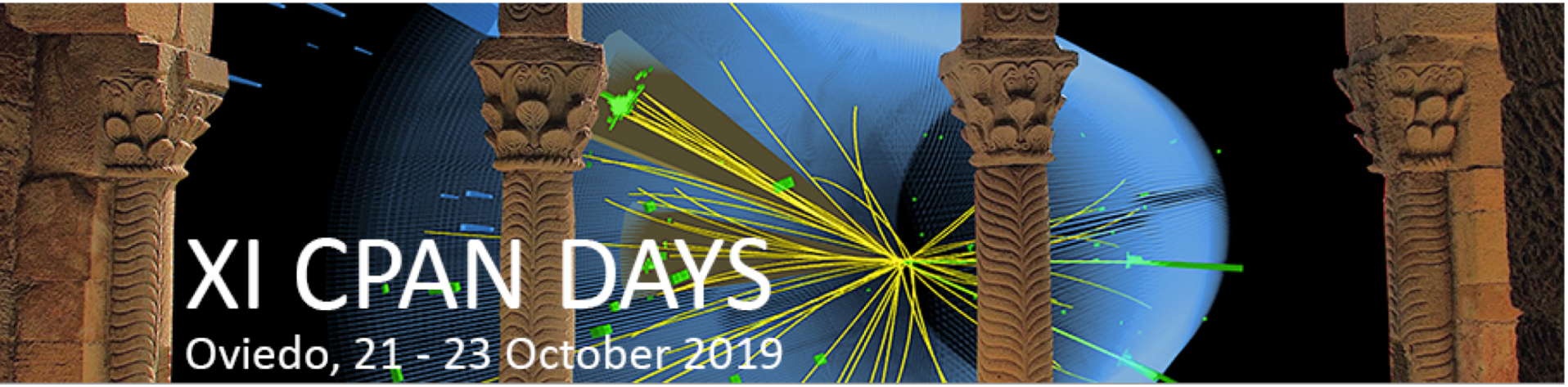
GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

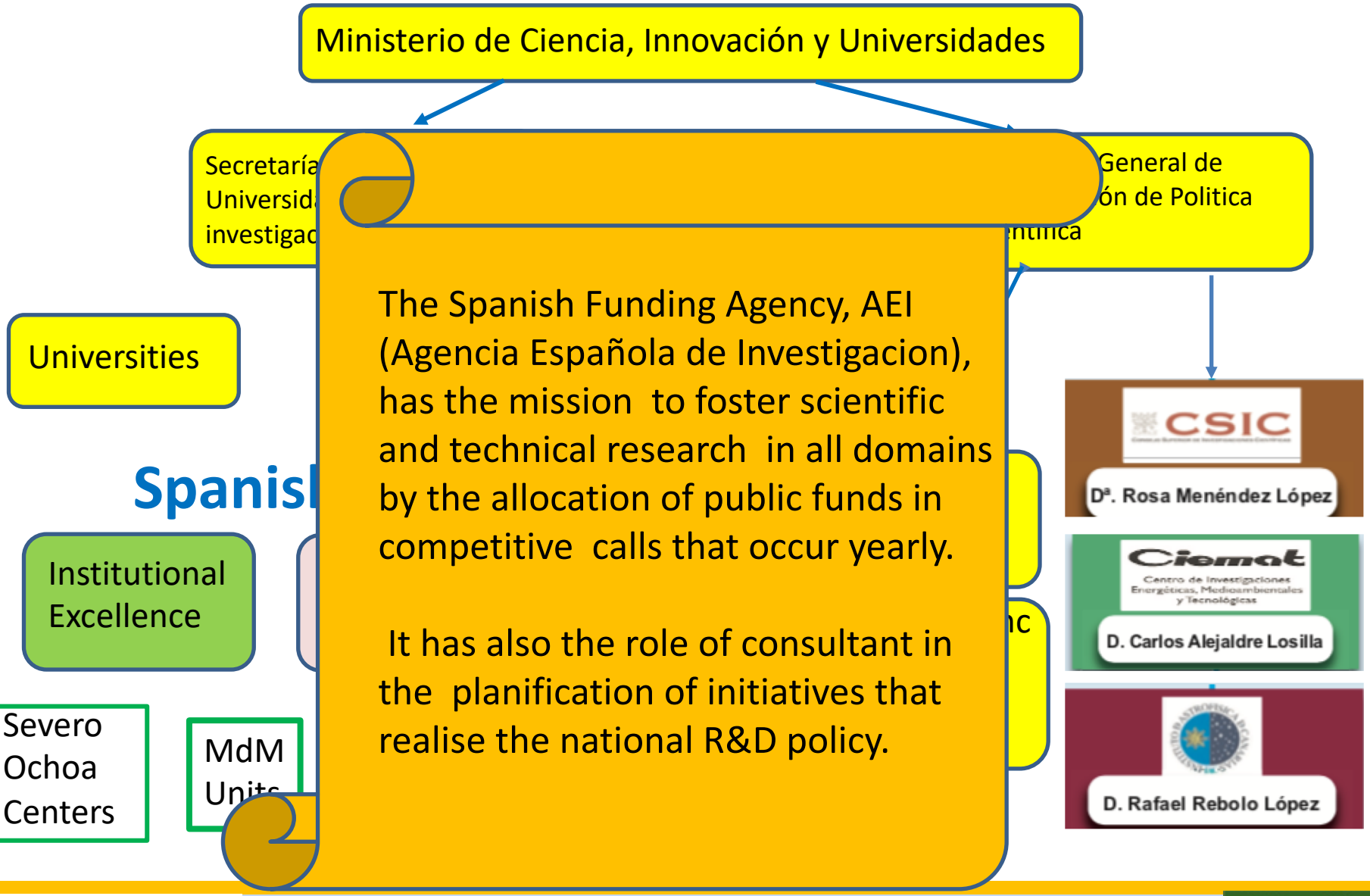


Funding FPA/FPN in Spain

María José García Borge (IEM-CSIC)
Elvira Gámiz (U. Granada)
Celso Martinez Rivero (IFCA)

Thanks to F. Del Aguila, J. Fuster and M. Martinez for the material

HEP-Spain: Organization & Funding



HEP Which areas ?

Collider **Physics**
Experiment (all) & Theory (all)

Nuclear Physics
Experiment (all) & Theory (some)

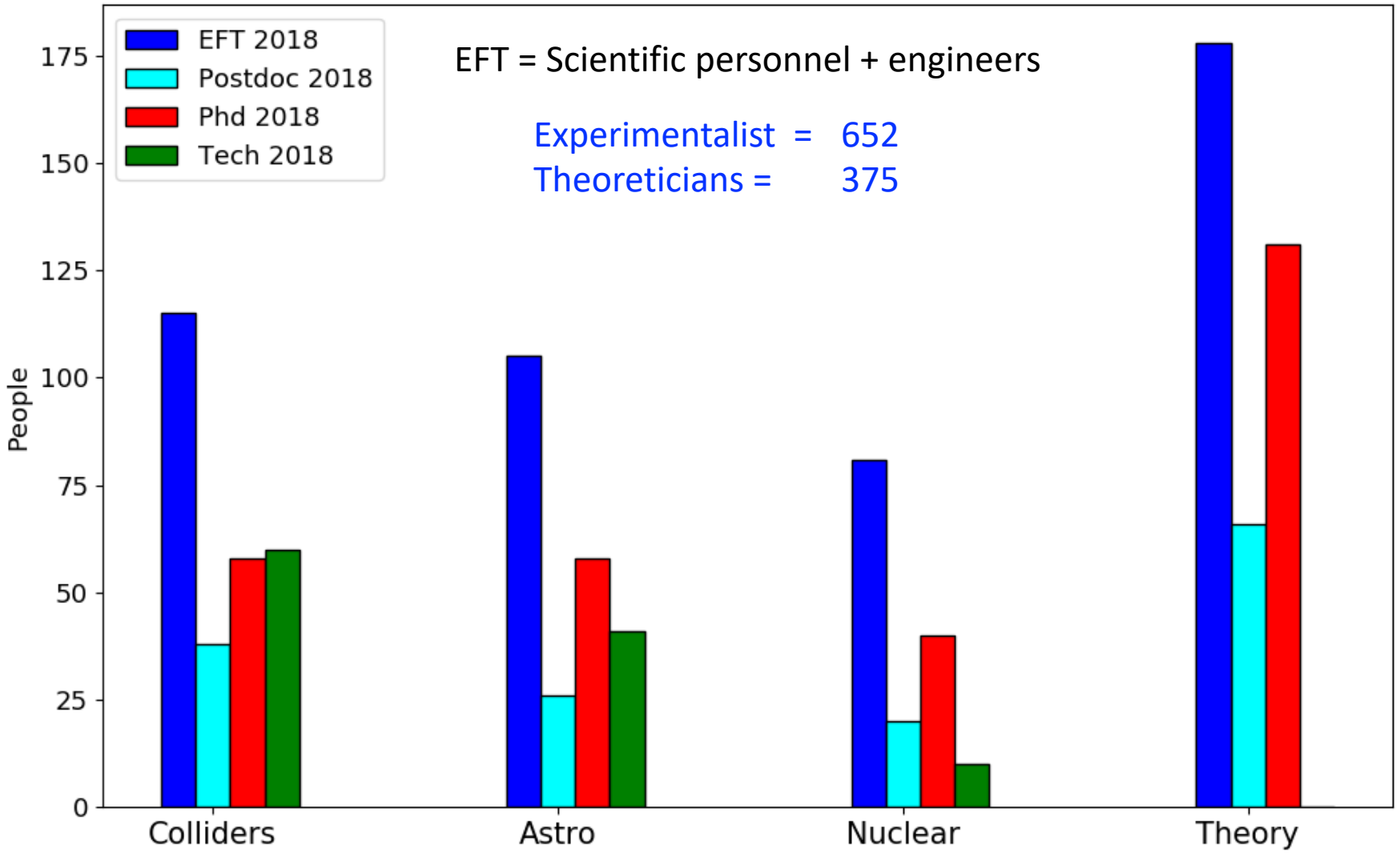
Astroparticle Physics & Neutrinos & Cosmology
Experiment (most) & Theory (some)

Information Technology
GRID (all), e-Science (some)

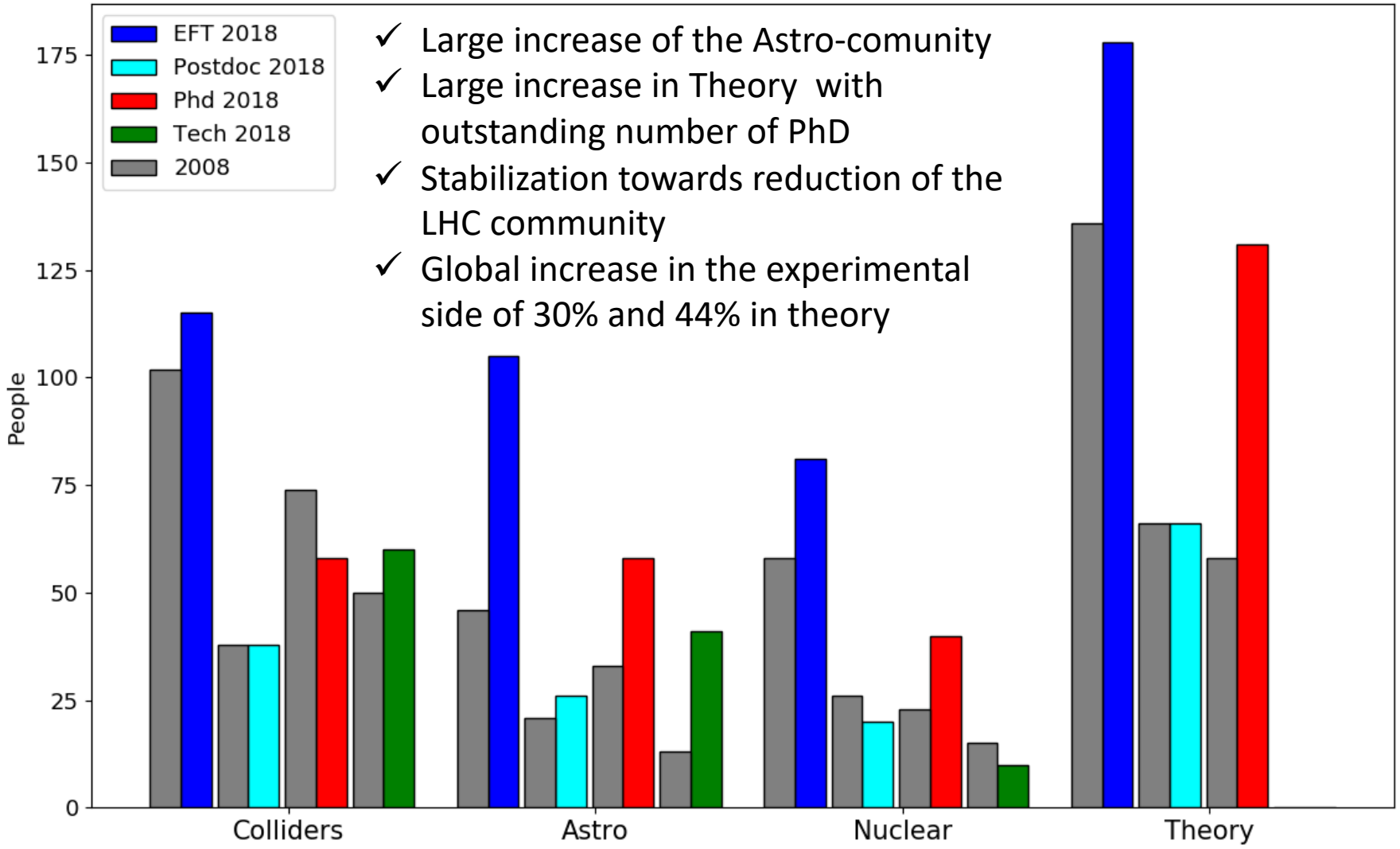
R&D in Accelerators and Detectors
(some)

Physics Applications
Medical Physics (some)

Human Resources (2016-2018)

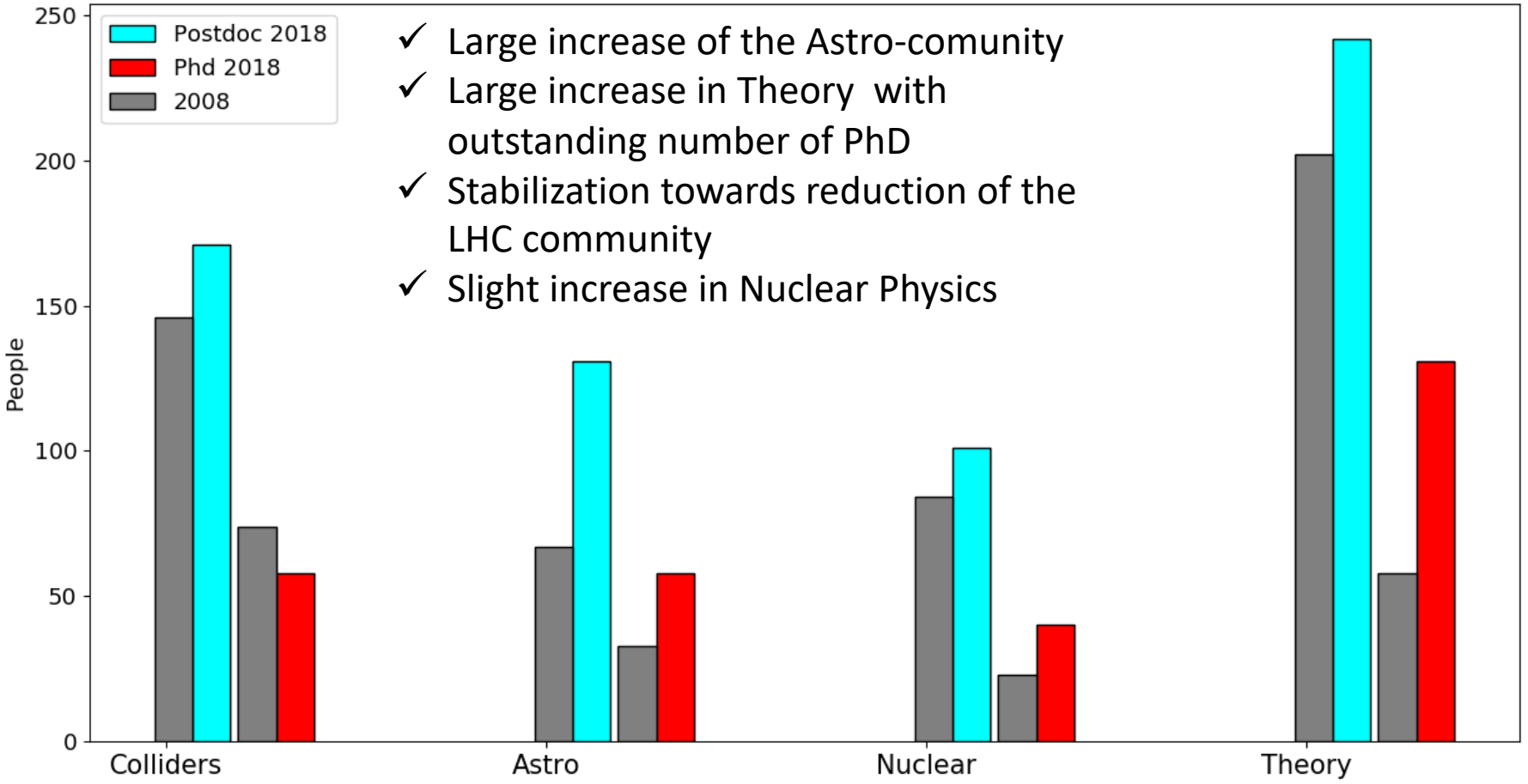


Human Resources: (2006-2008) → (2016-2018)



- ✓ Large increase of the Astro-comunity
- ✓ Large increase in Theory with outstanding number of PhD
- ✓ Stabilization towards reduction of the LHC community
- ✓ Global increase in the experimental side of 30% and 44% in theory

Scientific Resources evolution (2006-2008) → (2016-2018)

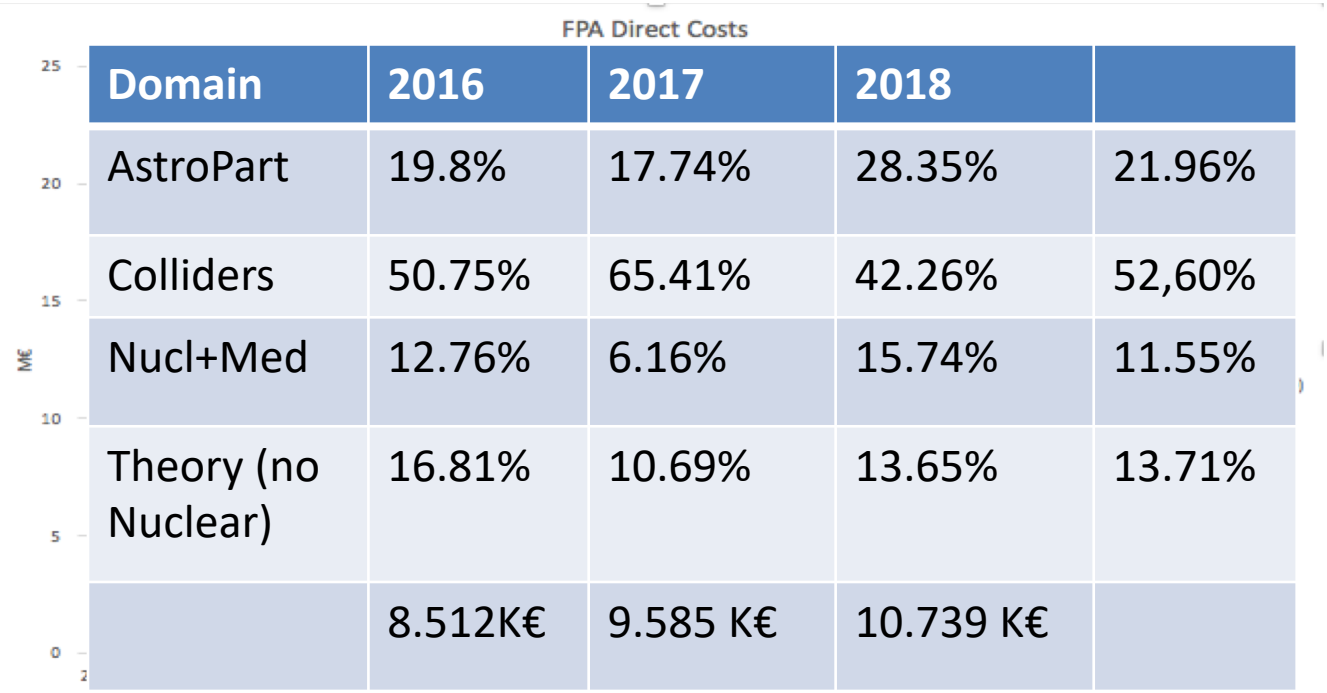


- ✓ Large increase of the Astro-comunity
- ✓ Large increase in Theory with outstanding number of PhD
- ✓ Stabilization towards reduction of the LHC community
- ✓ Slight increase in Nuclear Physics

HEP Landscape (FPA/FPN)

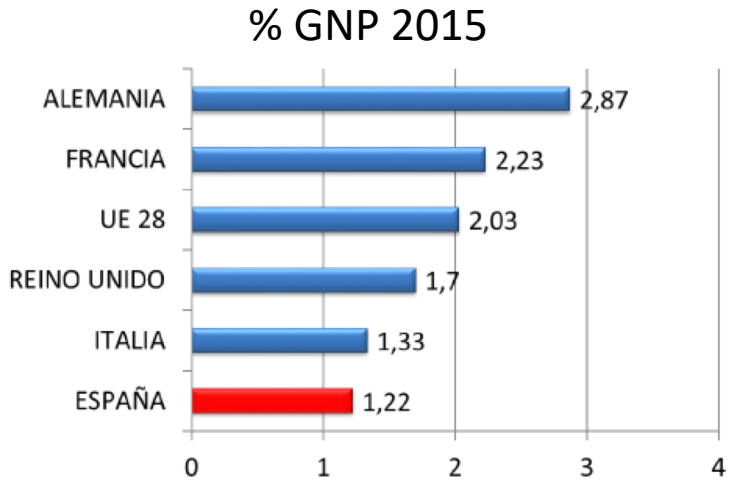
COLLIDERS	ASTRO/ COSMO/ NEUTRINOS/	NUCLEAR PHYS	R&D	THEORY
ATLAS	Pierre-Auger (20y)	ISOLDE	ACCELERATORS	LHC Pheno
CMS	T2K → HK	N-ToF	DETECTORS	Lattice
LHCB	WA105/protoDUNE	FAIR-RELATED	MEDICAL PHYS.	String/EFT
GRID	CAST/IAXO	AGATA		Nuclear Phys.
ILC/CLIC/FCC	LSC-RELATED (ArDM, ANAIS, NEXT, TREX,..)	OTHERS		……
	DES/PAU/DESI			
	CTA / MAGIC			
	ANTARES/KM3NeT			
	GW			

HEP program 2000 -2018



Domain	2016	2017	2018	
AstroPart	19.8%	17.74%	28.35%	21.96%
Colliders	50.75%	65.41%	42.26%	52,60%
Nucl+Med	12.76%	6.16%	15.74%	11.55%
Theory (no Nuclear)	16.81%	10.69%	13.65%	13.71%
	8.512K€	9.585 K€	10.739 K€	

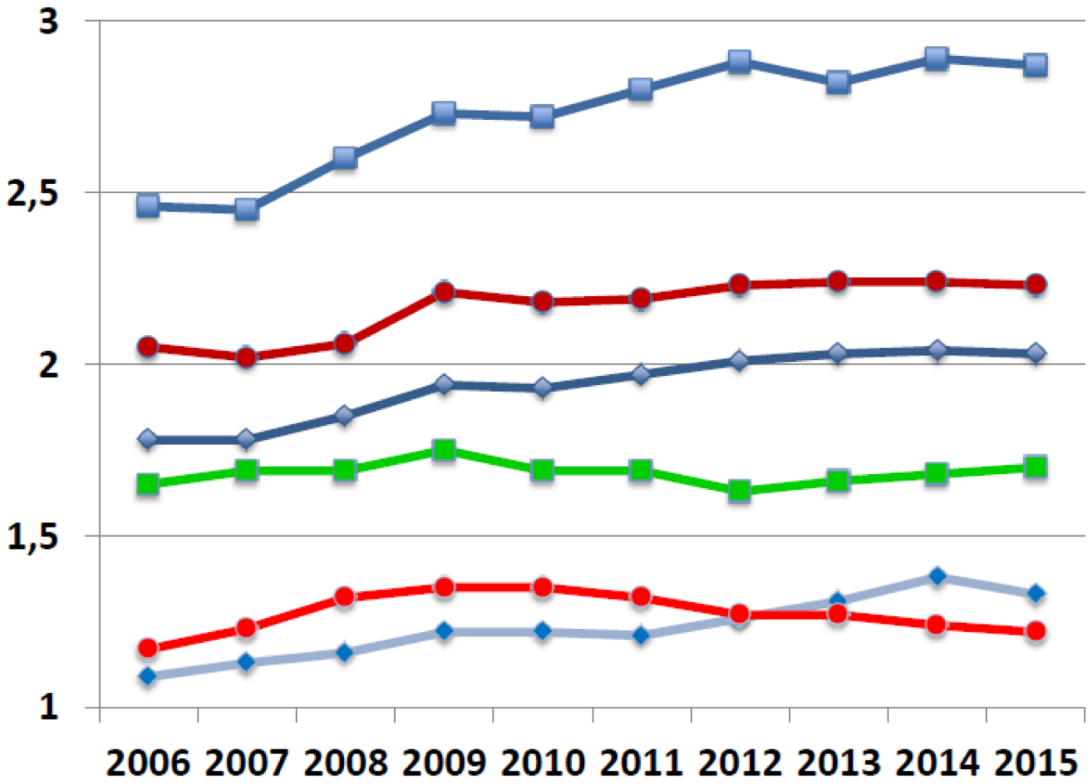
- Period >2010 represents ~60% of previous funding in average.
- However, we have a sizeble increase since 2016.
- Since 2013 the M&O of the experiments are included in the competitive called for projects. Large burden!
- In the 2018 call, the M&O for CERN experiments were not included as a dedicated budget was comtemplated in the draft of the General State Budget of 2019. They were added



Main Economies in EU

Investment in R&D (from 2015)

Evolution of % GNP 2006-2015



Germany

France

Average EU=2.03%

UK

Italy

Spain

Organization and Funding: Excellence Programme

Spanish Excellence Programme (started in 2012):

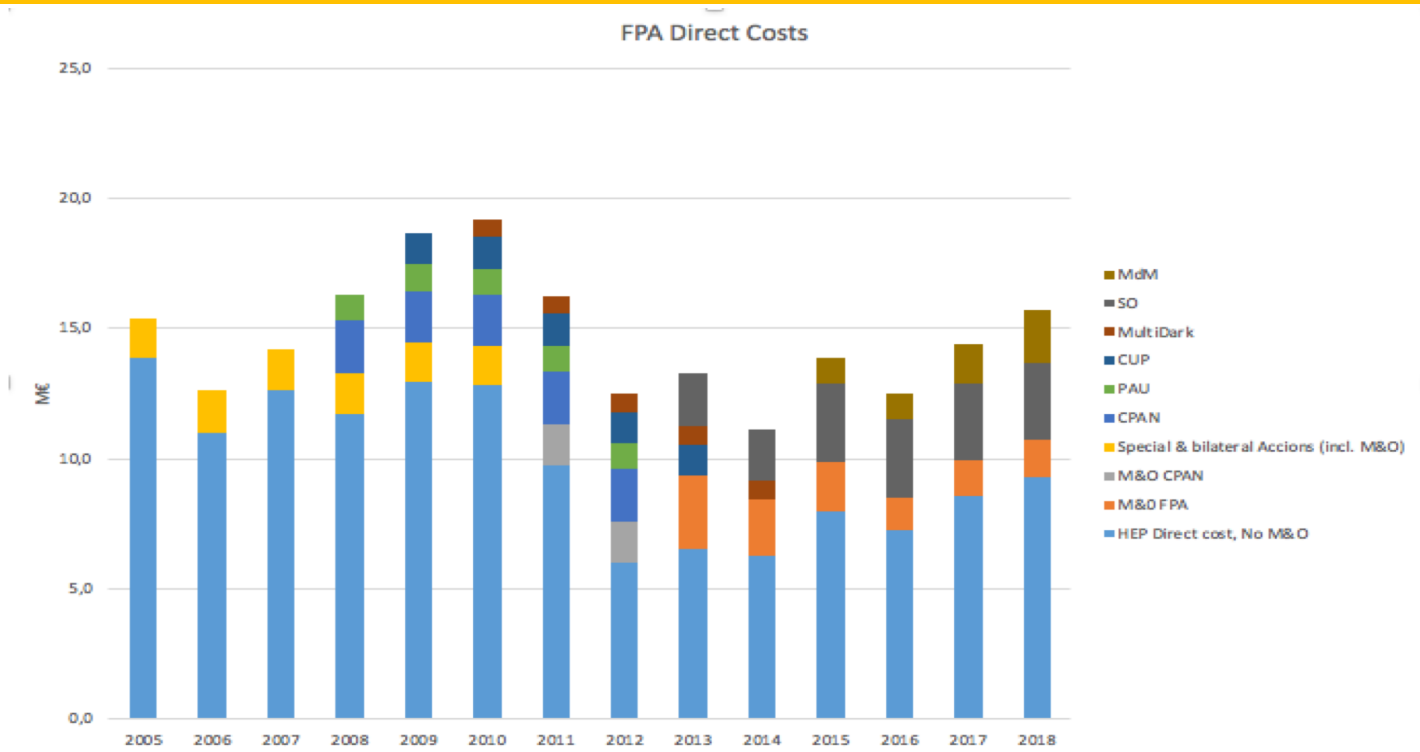
These nominations represent a recognition of scientific excellence, extra funding and additional PhDs grants.

- *Severo Ochoa Centres –SO-* (1 M€/year):
  - IFT (Instituto de Física Teórica, Madrid) (2013-2017), (2018-2021)
  - IFAE (Institut de Física de Altes Energies, Barcelona)(2012-2016)(2017-2020)
  - IFIC (Institut de Fisica Corpuscular, València) (2016-2019)– Not Renovated !

- *María de Maeztu Units* –MdM- (0,5 M€/year):
  - CIEMAT (Física de Partículas - Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, Madrid)
  - ICCUB (Institut de Ciències del Cosmos, Barcelona) Not Renovated !
  - IGFAE (Instituto Gallego de Física de Altas Energías, Santiago de Compostela)
  - IFCA (Instituto de Física de Cantabria, Santander)

30 SO and 23 MdM In Spain → Our field has 7 Centres (16%)

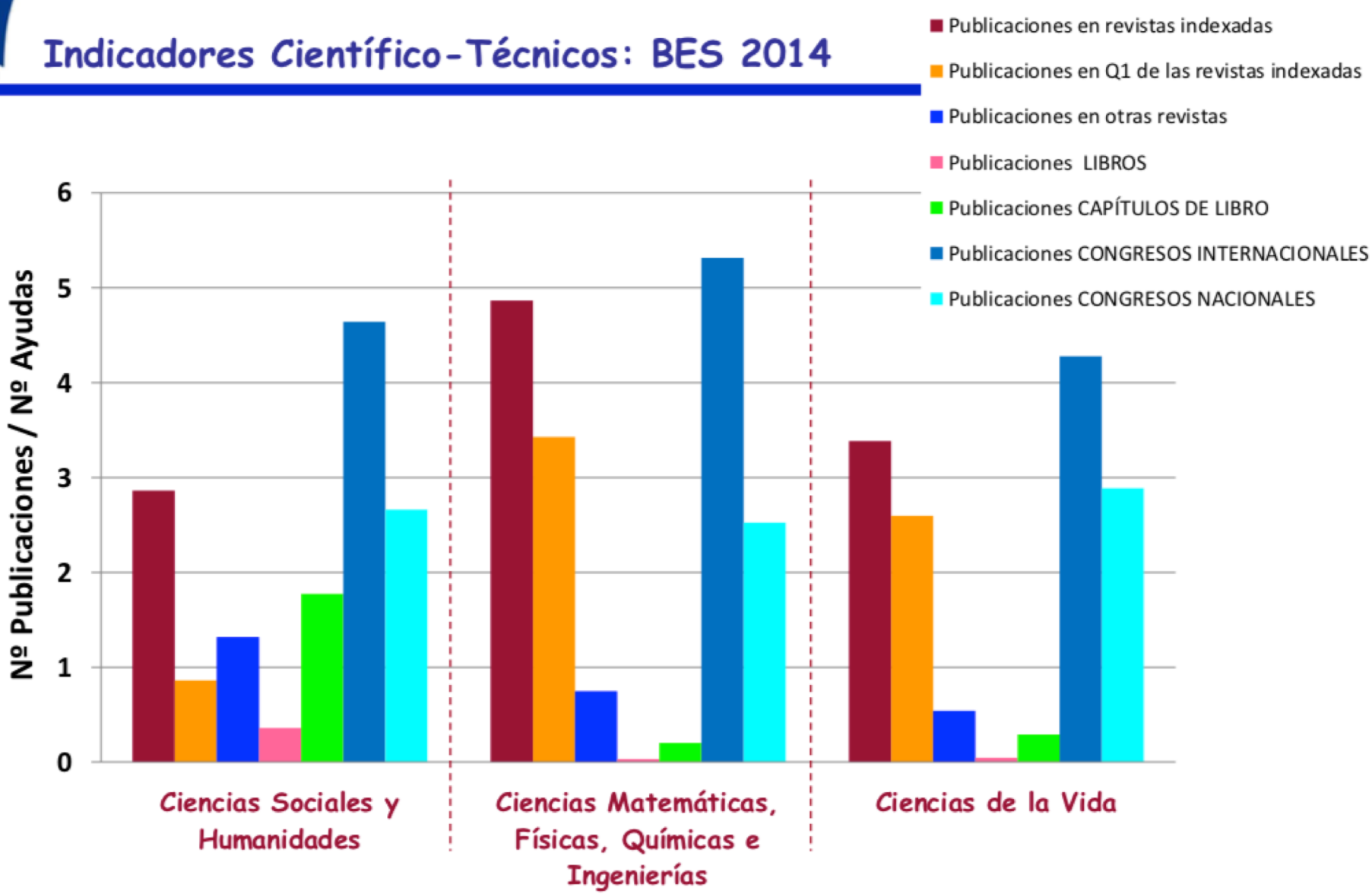
Funding profile + Severo Ochoa + María de Maeztu



- Spanish Excellence Programme (SO and MdM) helps to survive but
  - ❖ Only to some Institutes.
  - ❖ Increases the difference between groups.

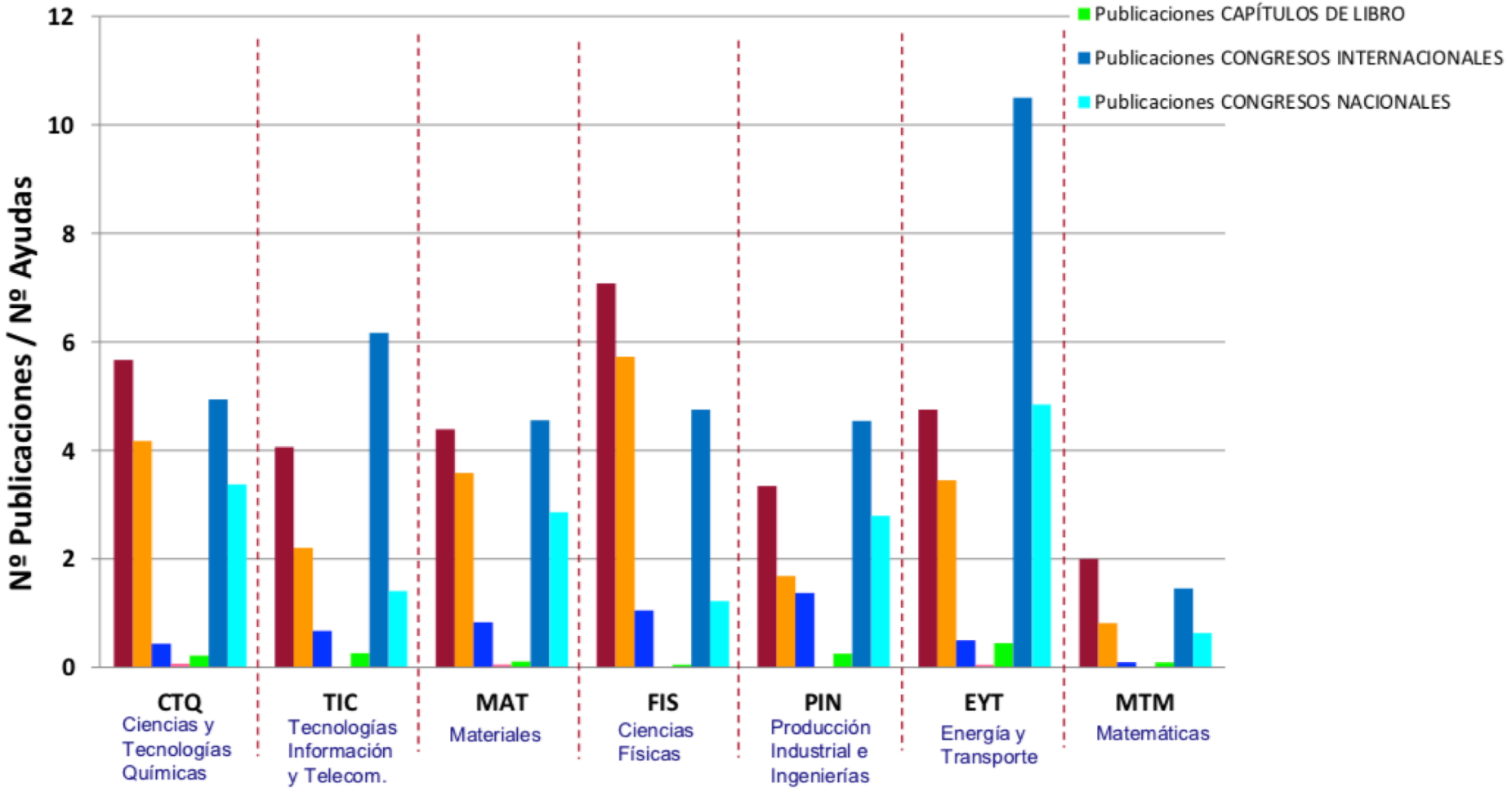
→ **Big challenge with present situation for HL-LHC contributions**

Indicadores Científico-Técnicos: BES 2014



Indicadores Científico-Técnicos: BES 2014

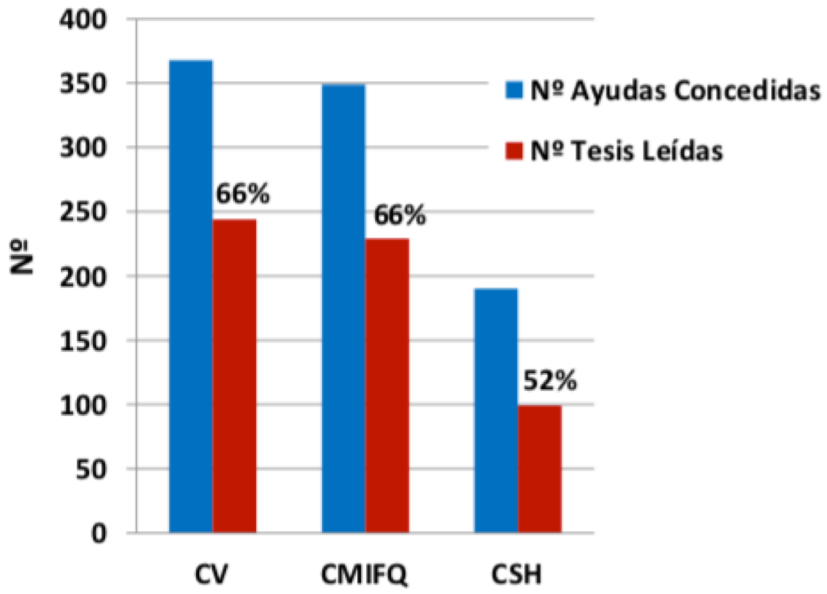
Ciencias Matemáticas, Físicas, Químicas e Ingenierías



PhD Statistics

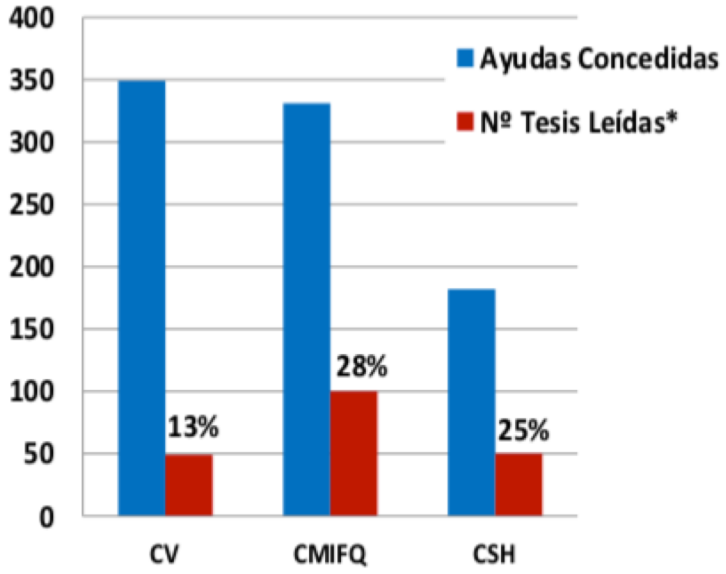
After 5 years !

2013: 63% Lectura de Tesis *



After 4 years !

2014: 23% Lectura de Tesis**



CV: Ciencias de la Vida **CMIFQ**: Ciencias Mat., Fis.,Quím. e Ingenierías **CSH**: Ciencias Sociales y Humanidades

* Datos TESEO hasta aproximadamente 1 año después de finalizar los 4 años de ejecución

** Datos AEI a los 4 años de ejecución y a falta de que finalicen 15 ayudas

Evaluations done since 1st July 2018

- Convocatoria de infraestructuras
- Convocatoria proyectos nacionales
- Alegaciones proyectos nacionales
- Informes finales 2013,2014, 2015, 2016,…
- Informes de seguimiento proyectos
- Informes de seguimiento RyC y JdC
- Convocatoria de Técnicos de Apoyo
- Convocatoria de Redes
- Convocatoria de Redes
- Informes de seguimiento de RR.HH.: ayudas predoctorales, predoctorales Severo Ochoa, redes, técnicos de apoyo ...
- prorrogas
- I3
- Programa Athenea 2018 (Marie Curie cofund, Universidad de Granada)
- Incorporación de Doctores 2018 (Universidad de Granada)
- Contratación Investigadores UNED
- Programa de Incorporación Estable de Doctores
- Convocatoria JdC y RyC (y alegaciones)
- Proyectos Prometeo y Consolidables (Generalitat Valenciana)
- Programa de contratación de doctores: subprogramas Excelencia y Experiencia Internacional (Generalitat Valenciana)
- Infraestructuras Generalitat Valenciana
- Infraestructuras Univ. de Cantabria
- Postdocs y predocs País Vasco
- Evaluación de grupos Universidad de Oviedo
- Evaluación de grupos Principado de Asturias
- Proyectos Universidad de Murcia
- Postdocs Universidad de Murcia
- Programa de captación de talento (incorporación de doctores) de la Junta de Extremadura
- Creación de Instituto UCM

First Announcement of the 6th International INFIERI Summer School

(After Oxford, Paris, Hamburg, San Paulo, Wuhan)

on the complete signal processing for 21st Century instruments, for Master's, Ph.D students & Postdocs in Physics and Engineering from institutes worldwide.

http://uam.edu.cn/infieri2020

Registration starting on November 1st, 2019

INTELLIGENT SIGNAL PROCESSING FOR FRONTIER RESEARCH & INDUSTRY

July 6th - 18th, 2020

Universidad Autonoma de Madrid, UAM, Madrid, Spain

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

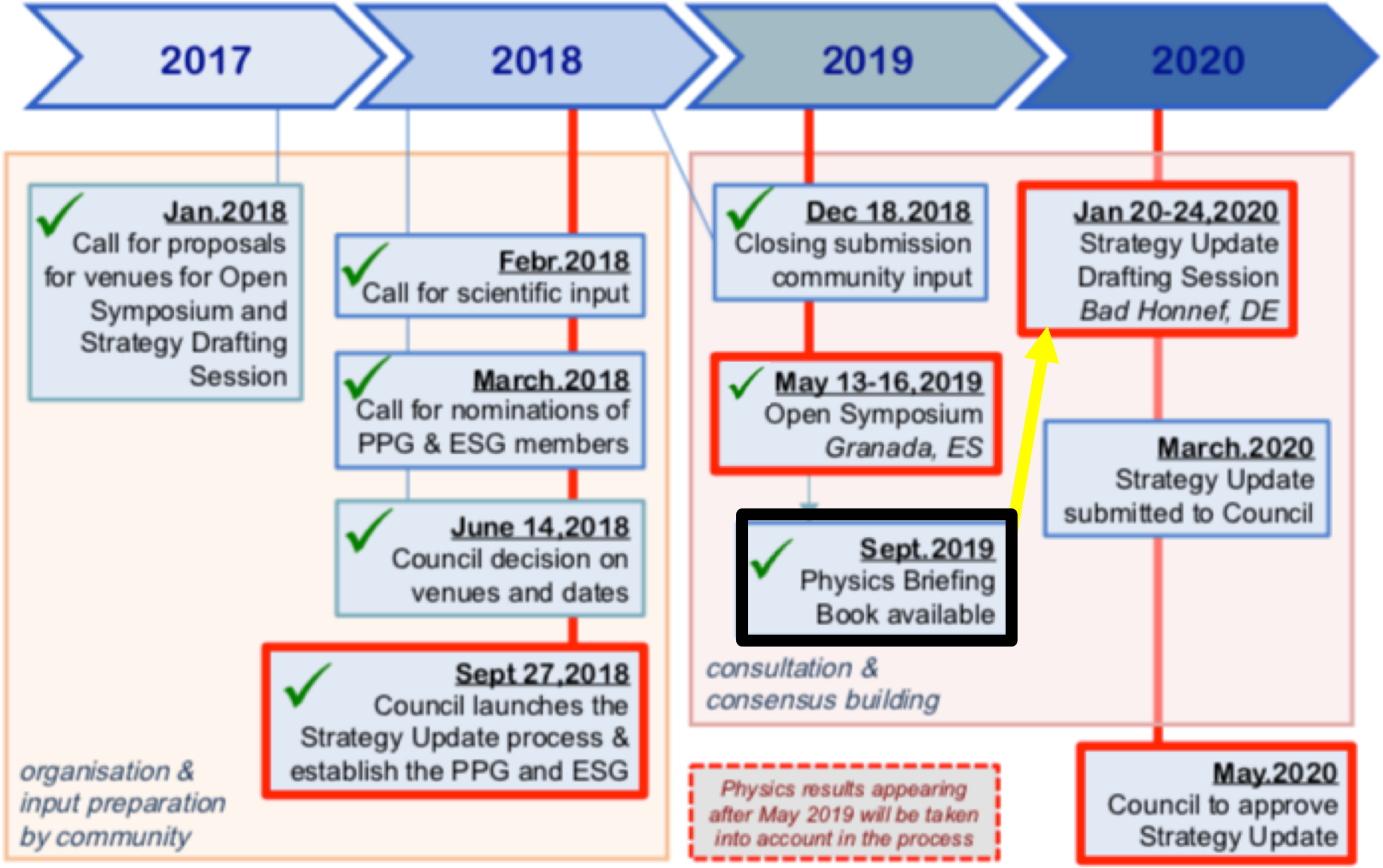
AGENCIA ESTATAL DE INVESTIGACIÓN

European Particle Physics Strategy Update 2020

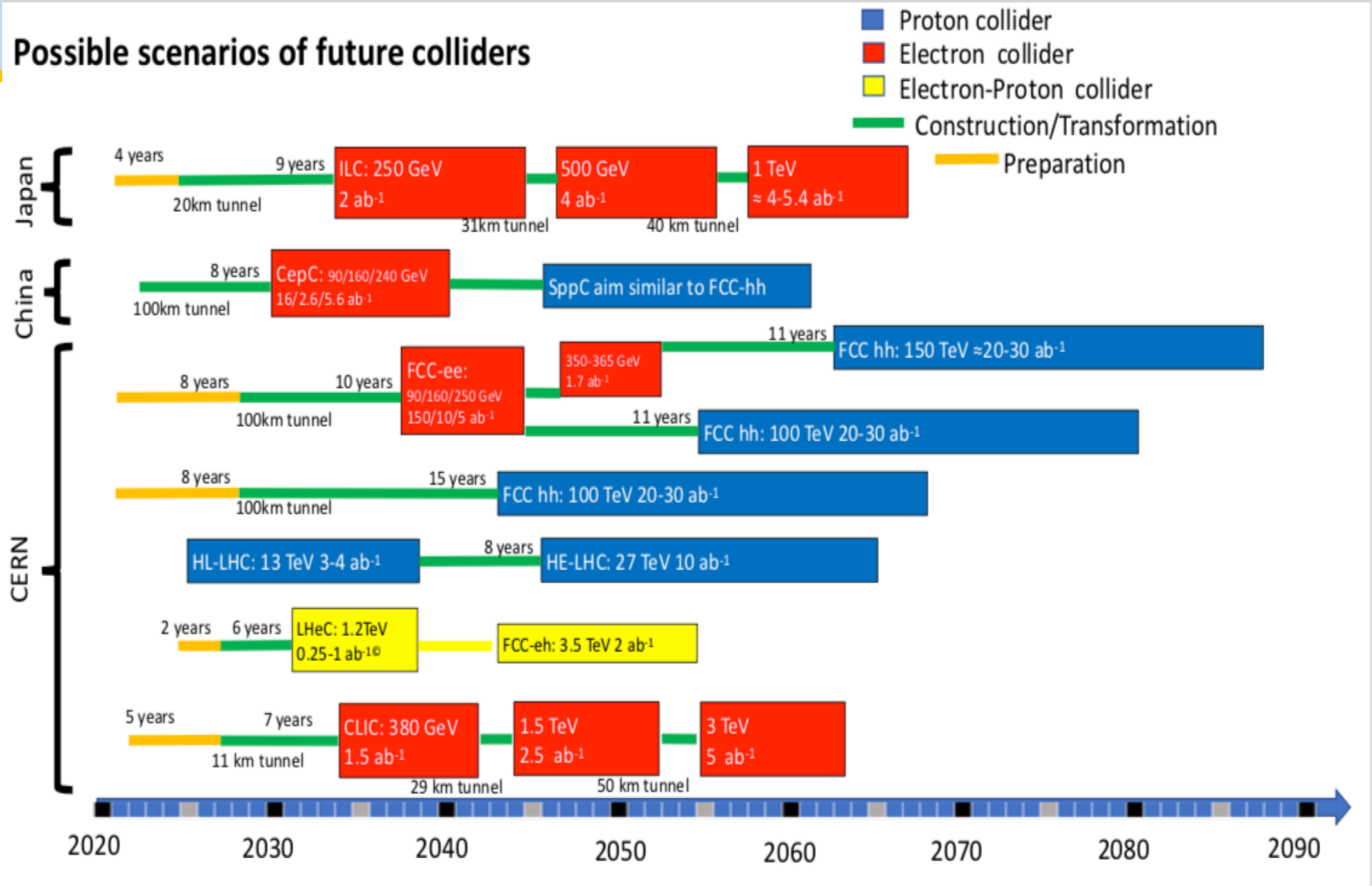
Big Success more than 600 Participants,

Thanks to local Organizer Team!!

European Strategy Update

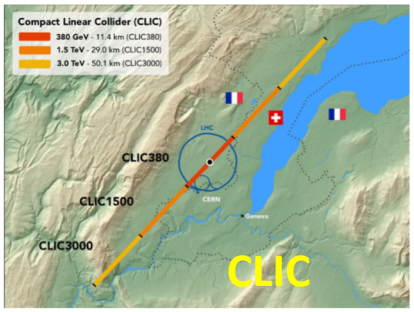

2017
2018
2019
2020
Jan.2018
Call for proposals for venues for Open Symposium and Strategy Drafting Session
Febr.2018
Call for scientific input
March.2018
Call for nominations of PPG & ESG members
June 14,2018
Council decision on venues and dates
Sept 27,2018
Council launches the Strategy Update process & establish the PPG and ESG
organisation & input preparation by community
Dec 18.2018
Closing submission community input
May 13-16,2019
Open Symposium
Granada, ES
Sept.2019
Physics Briefing Book available
consultation & consensus building
Physics results appearing after May 2019 will be taken into account in the process
Jan 20-24,2020
Strategy Update Drafting Session
Bad Honnef, DE
March.2020
Strategy Update submitted to Council
May.2020
Council to approve Strategy Update

Possible scenarios of future colliders

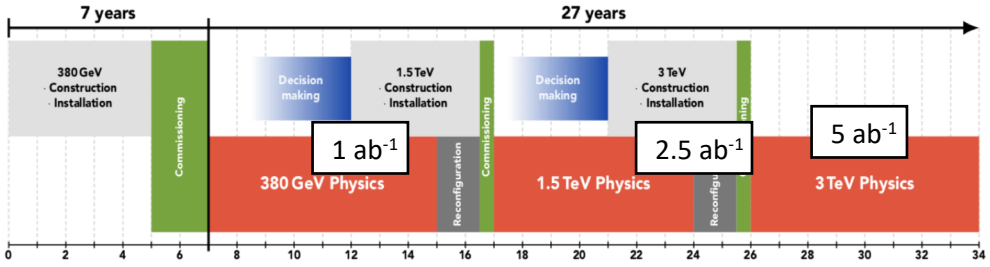


Presentation by Fabiola in Granada

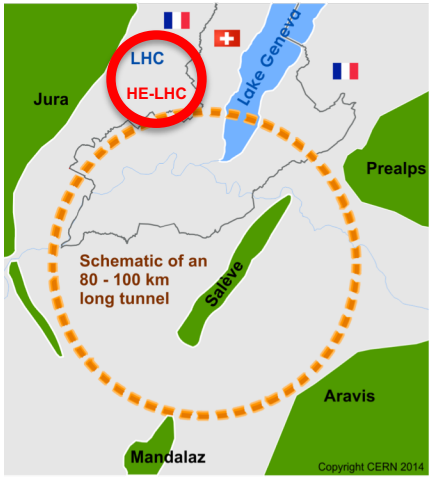
CLIC (Compact LInear Collider) : multi-TeV e^+e^- linear collider



Technically:
construction could start in ~2026 (TDR in 2025)
→ start operation at √s=380 GeV in ~2035



FCC: Future Circular Collider



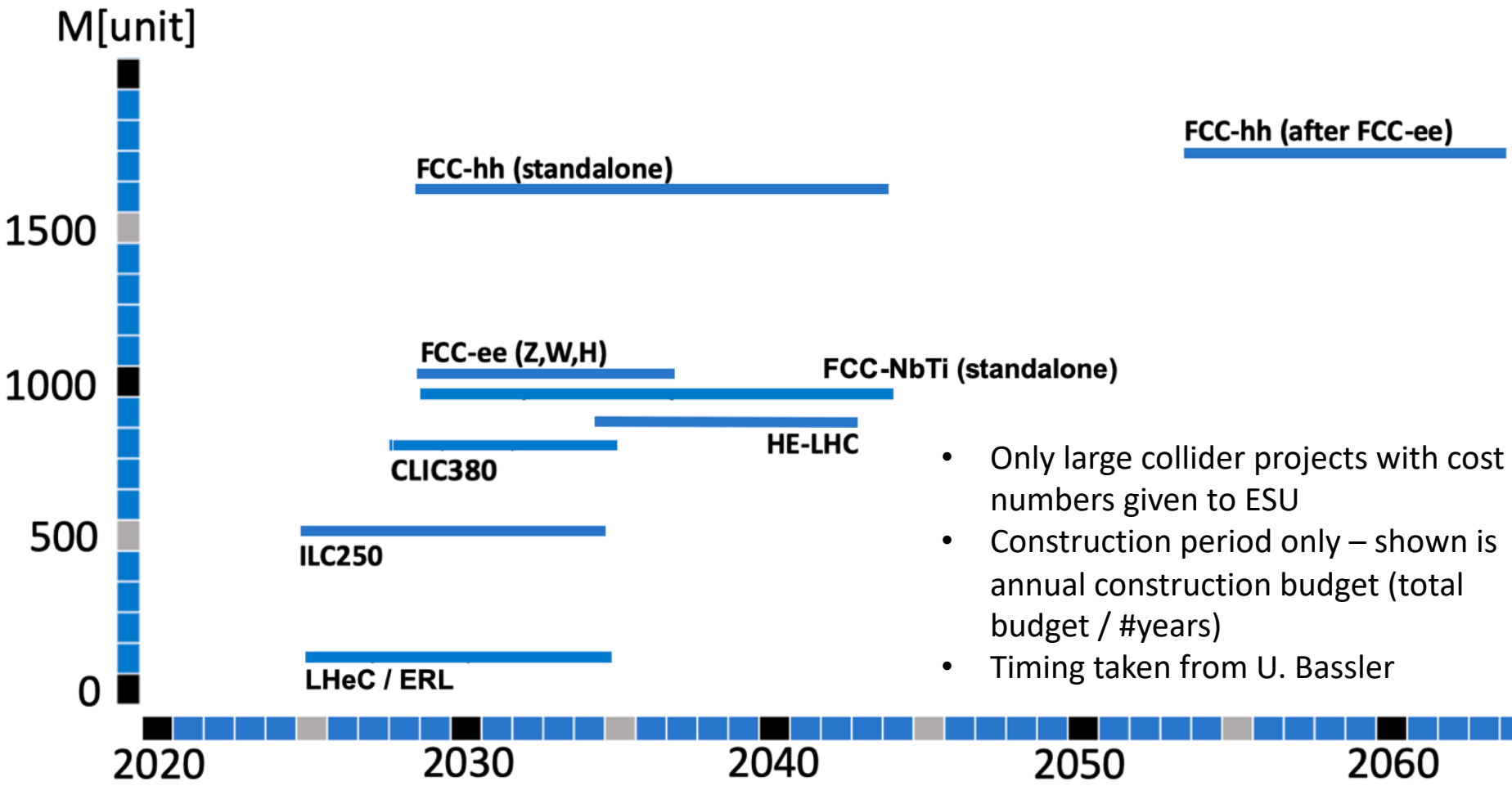
	√s	L /IP ($cm^{-2}\,s^{-1}$)	Int. L /IP(ab^{-1})	Comments
e^+e^- FCC-ee	~90 GeV Z 160 WW 240 H ~365 top	230 x10^{34} 28 8.5 1.5	75 ab^{-1} 5 2.5 0.8	2 experiments Total ~ 15 years of operation
pp FCC-hh	100 TeV	5 x 10^{34} 30	2.5 ab^{-1} 15	2+2 experiments Total ~ 25 years of operation
PbPb FCC-hh	$\sqrt{s_{NN}}$ = 39 TeV	3 x 10^{29}	65 nb^{-1}/run	1 run = 1 month operation
ep Fcc-eh	3.5 TeV	1.5 10^{34}	2 ab^{-1}	60 GeV e- from ERL Concurrent operation with pp for ~ 20 years
e-Pb Fcc-eh	$\sqrt{s_{eN}}$ = 2.2 TeV	0.5 10^{34}	1 fb^{-1}	60 GeV e- from ERL Concurrent operation with PbPb

Also studied: HE-LHC: √s=27 TeV using FCC-hh 16 T magnets in LHC tunnel; L~1.6x10^{35} → 15 ab^{-1} for 20 years operation

Large-Scale Projects > 1 Billion (EUR, $, CHF)

	ID	Name	Timeline	Cost	Comment	Level
CERN	146	CLIC (acc+det)	7 years construction	5890 MCHF 397 MCHF	(±20%); 380 GeV machine, drive-beam-based (klystron machine 7290); detector 397 MCHF	1
	132	FCC-ee (Z, W, H)	18 years until physics (10 years construction)	10500 MCHF +1100 MCHF	(±30%); Capital cost for three working points (Z,W,H); operation costs 85 MEUR/year (electricity, today's prices) For ttbar stage	1
	133	FCC-hh (after FCC-ee)	Physics 25 years after start of ee physics	17000 MCHF	(±30%); Capital cost with preceding ee; operations costs 180 MEUR/year (electricity, today's prices).	1
	133	FCC-hh stand-alone	23 years until physics (15 years construction)	24000 MCHF	(±30%); Stand-alone capital cost (no ee before); operations costs 180 MEUR/year (electricity, today's prices).	1
		FCC-NbTi stand-alone	23 years until physics (15 years construction)	14900 MCHF	(±30%); Capital cost; operation's costs: 400 MW compared to 580 MW for FCC-hh --> by scaling: 124 MEU/year (electricity, today's prices)	1
	136	HE-LHC	23 years until physics (8 years construction)	7200 MCHF	(±30%); Capital cost; operation costs 55 MEUR/year (electricity, today's prices)	1
		FCC / HE-LHC detectors	---	---	No input to ESU	
Japan	66 / 77	International Linear Collider (ILC250)	10 years construction	4800-5300 MILCU 7980 MILCU	(±25%); For ILC250, plus 10 kFTE years; European contribution to non-CFS? ILC500, plus 13.5 kFTE years	1
	107	International Large Detector	O(9-10 years)	400 MEUR	Large European participation	1
		SiD	O(9-10 years)	---	Smaller European participation	3
China	51	CEPC accelerator	Decision >2020	---	European contribution unclear	3
	29	CEPC detector	---	---	European contribution unclear	3

Large-Scale Projects > 1 Billion (EUR, $, CHF)



- Only large collider projects with cost numbers given to ESU
- Construction period only – shown is annual construction budget (total budget / #years)
- Timing taken from U. Bassler

ESPP Project Costs | 21 June 2019 | Courtesy of J. Mnich

Cost of Tunnel included

Future HEP Project Priorities: Summary

- **Clear preference for an e+e– collider as the next h.e. collider: (14/15)**

– as H-factory and for precision e.w. measurements (ILC, CEPC, FCC-ee, CLIC)

-significant demands for upgradeability to access tt (ILC, CEPC, FCC-ee, CLIC) and also HH and ttH final states (ILC+; CLIC

- **Second priority: R&D for future h.e. Collider(**7/15)/ h.f. s.c. magnets for hadron colliders, and also novel accelerator techniques (PWA, μ-collider)
- **Third priority:** future hadron collider beyond LHC (4/15) (FCC-hh; fewer demands for he-LHC and eh-collider)
- large diversity of other, "smaller" projects (PBC, neutrino, DM searches, precision/intensity frontier, nuclear, astro-particle, ...

European Particle Physics Strategy Update 2020

- Briefing Book Document from 30th of September distributed. (Halina Abramowitz) Comments recieved in the last month included.

- Meeting of ESG in June: we agreed that we need to prepare various options that would go back to the communities for comments with prioratisation

- Several components to each option (in intervals of 20 years)
  o Short-term (HL-LHC) – always included
  o Mid-term (Higgs factory) – what about CERN if ILC or CEPC become reality?
  o Long-term (future facility)

- In September it was circulated a document that had three options for mid- and long-term: CLIC-all; FCC-all; CLIC-FCC
  - FCC-LE followed by FCC(p,A,(e)) was added
- **Consider to add options**
  o CLIC380 followed by plasma acceleration of muons and/or muon collider in LHC tunnel (SB)
  o (If ILC/CEPC) LHeC followed by FCC/or new technology (HA)
  o Postpone decision till next strategy (HA)

Scenarios (ESG)

	2020-2040	2040-2060 1st gen technology	2060-2080 2nd gen technology
CLIC	HL-LHC	CLIC380-1500	CLIC3000
CLIC-FCC-mixed	HL-LHC	CLIC380	FCC-h/e/A (Adv HF magnets)
FCC	HL-LHC	FCC-ee (90-365)	FCC-h/e/A (Adv HF magnets)
LE-to-HE-FCC-h/e/A	HL-LHC	LE-FCC-h/e/A (LF magnets)	FCC-h/e/A (Adv HF magnets)
LHeC+FCC-h/e/A	HL-LHC + LHeC	LHeC	FCC-h/e/A (Adv HF magnets)

The last two scenarios asume e+/e- accelerators elsewhere

- o Arguments pro & con on the physics program
- o Arguments on the technical, financial and organization feasibility
- o Arguments on the community support
- o Verification if we collect with the above list, adequate and sufficient elements to be considered for this and the next strategy update

Questions

- In the absence of clear indications for new physics, is a broad exploration an adequate approach for our global field? Do we want to move forward in the largest variety of directions?

- Would it be appropriate/sufficient to move the scientific diversity program at CERN or at the National Institutes to among the highest priorities for Europe?
- Should we consider statements to strengthen the LHC and HL-LHC program?

- Should we also support the fixed-target projects at (HL-)LHC?

- should we consider for the period beyond LS4 a choice between the next generation heavy-ion experiments at the HL-LHC and the LHeC?

Questions II

- Do we remain open towards strong participation in future collider programs outside Europe?

- (2013) Is the continuation of the CERN Neutrino Platform appropriate? Should we propose to extend the scope of the Neutrino Platform beyond long-baseline neutrino projects?
- (2013)“Europe should support a diverse, vibrant theoretical physics programme, ranging from abstract to applied topics,. Should we strengthen this statement?
- (2013) “*Detector R&D programmes should be supported strongly at CERN, national institutes, laboratories and universities* . Should we strengthen this statement?

Questions III

- Should we make concrete the technology collaboration with the gravitational wave community?

- Should the HE-LHC feature in our strategy update?

- In the context of the LE-to-HE-FCC-h/e/A scenario, would an evolution from 6T to 16T/HTS magnets for FCC-h/e/A be an avenue to explore?

The floor is Yours !

Response: **Spanish network for future colliders**

The global HEP programme will be led by **Europe**, but that contributions and facilities will not be limited to Europe.

in particular on the fate of collider projects in Asia, and the discussion of future installations in Europe must take into account the international environment.

Electron-positron Higgs factory and precision measurements at the energy frontier

- If the Japanese government decides to host the ILC, the Spanish network recommends that CERN and Europe should take a pro-active role in the Project→we should ensure that the facility provides a world-class "Higgs factory" programme and should pursue a timely energy upgrade.
- If the negotations between Europe and Japan to build the ILC in Japan should not bear fruit, Europe should take responsibility for building the electron-positron Higgs factory. The CLIC380 initial stage should, at that point, become the first priority of the CERN programme.

In the relevant energy range a **linear collider offers** a more cost-effective solution than a circular collider once all costs (including civil engineering and operating costs) are accounted for on an equal footing.

The proposed circular collider in China (CEPC) should be followed, Not expected to come in time to influence the current update of the European strategy for particle physics.

Response: **Spanish network for future colliders**

Exploration of the energy frontier in the mid-term (2040-2060)

Complementary to the precision measurements of the Higgs sector→ The exploration of the energy frontier remains Important. With the LHC, Europe will continue to lead the global effort until well into the 2030s.

A hadron collider based on super-conducting magnet technology forms a baseline solution. The LE-FCC based on established magnet technology, and with a 40-50 TeV collision energy, offers an interesting trade-off of ambition and cost. Realization on the relevant time line depends on a rapid design and decision-making process, but is not excluded. In case Europe should decide not to host an electron-positron collider, this is the preferred scenario.

Longer-term future (2060-2080)

Long-term future of the field is harder to formulate.

We therefore cannot confidently commit to a concrete project for the end of the 21st century.

The strategy for the next installation should be flexible.

A vigorous R&D programme is required to make sure the technology is available for continued exploration.

Novel accelerating technologies can offer a more cost-effective solution for a high-energy collider,

The next update of the strategy should answer this question.

A focussed R&D effort is required to assess the feasibility of an **energy frontier muon collider** or advanced **linear collider based on plasma wakefield acceleration**.

Large-Scale Projects < 1 Billion (EUR, $, CHF)

	ID	Name	Timeline	Cost	Comment	Level
CERN-based	12	SHiP	Physics in 2027	70 MCHF	Detectors, muon shield, including infrastructure (see also ID 129 SPS beam dump facility)	1
	129	SPS BDF	Available 2027	156.3 MCHF	Material cost estimate (see also ID 12 SHiP)	1
	17	n_TOF	---			3
	36	Dark sector with primary electron beam @ CERN	eSPS commis-sioning 2024 (5 years after decision)	79.5 MCHF	Source, accelerator, beamlines, civil engineering, infrastructure; LDMX cost < 10 MCHF; start ≥ 2024	1
	39	EPIC / ISOLDE	Commissioning 2027	101 MCHF		1
	58	AWAKE++	Installation in LS3?	---	NA64-type fixed-target experiment	3
	110	Next-generation LHC HI exp.	R&D etc. ongoing; installation during LS4 (2030)	150 MCHF	Detector cost	1
	151	BSM searches with HI collisions at LHC	---	No significant investment	Extended HI running beyond 2029	2
	143	QCD facility at M2 beamline at SPS	---	10-20 MCHF	Spectrometer / detector; beamline costs being studied; programme start ≥ 2022	2
	153	KLEVER	Installation 2025 (LS3)	38.95 MEUR	Detector cost, plus 6-12 MCHF for beamlines and exp. area. Preliminary. Operation costs / year: 550 kEUR	1